ACL injury. Overall, those with ACL injury and reconstruction have poor motor control leading to increased rotational loading, a contributing factor to OA. The coupling of medial shear force and valgus collapse put patients at risk for re-injury and results in increased TKM that contribute to OA progression.

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COMPARISON OF ISOLATED AND COMBINED ORTHOTIC DEVICES ON KNEE LOADING WHILST ASCENDING STAIRS IN PATIENTS WITH MEDIAL KNEE OSTEOARTHRITIS

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Purpose: Valgus knee braces and lateral wedged insoles are common modalities used in the treatment of medial tibiofemoral osteoarthritis (OA) of the knee joint. Both treatments have been shown to reduce the external knee adduction moment (EKAM) during walking conditions, and more recently during stair ascent and descent. There is evidence suggesting that combining these treatments during walking tasks (by altering the position of the knee joint centre with the knee brace and the orientation of the ground reaction force with a lateral wedge insole) produced a greater overall reduction of the EKAM. Stair ascent is a common and frequent activity in daily living and demands, compared to walking on level ground, a greater range of motion and around six times more load on the knee joint. Therefore, determining whether insoles, braces or a combined approach reduces loads in patients with medial knee OA is warranted. The hypothesis of this study was that a combined orthotic management of a valgus knee brace and lateral wedged insole was better at reducing EKAM than the single treatments alone.
Methods: Participants underwent a 3D kinematic (Qualysis OQUS, Gothenburg, Sweden) and kinetic (AMTI, USA) analysis whilst ascending three stairs in a control shoe, an off-the-shelf lateral wedge insole (Salford Lateral Wedge) inserted bilaterally into the control shoe, an off-the-shelf Ossur UnloaderOne valgus knee brace, both the lateral wedge insole and valgus knee brace combined, in a randomised order. During trials, lateral wedge insoles were inserted into the control shoes and were worn bilaterally and trials were fully randomised with a minimum of three trials per condition. The EKAM was calculated and exported during single support only as this is the phase of the stair cycle where loading is at its maximum. Peak early-single support (0-33%) EKAM; peak mid-single support (34-66%) EKAM; and peak late-single support (67-100) EKAM were extracted along with the knee adduction angular impulse (KAAI) for support phase only. A repeated measures of analysis of variance was undertaken to determine any significant differences at the 95% Confidence interval ($p<0.05$) between the control shoe and the orthotic conditions.
Results: Seven participants (5 female, 2 male) were radiographically confirmed with medial knee OA. The combination of the valgus knee brace and lateral wedged insole significantly reduced the early-single support EKAM ($p = 0.04$) compared to the control shoe. However, during mid-single support only the lateral wedged insole reduced EKAM was significantly different ($p =0.004$) to the control shoe. During late-single support the lateral wedged insole and the combined valgus brace and lateral wedged insole reduced the EKAM significantly in comparison to the control shoe ($p = 0.021$ and $p = 0.033$ respectively), with the combined valgus knee brace and lateral wedged insole reducing EKAM significantly in comparison to the valgus knee brace alone ($p=0.046$). The KAAI was significantly reduced for the insole ($p = 0.003$) and the combined lateral wedged and valgus knee brace ($p = 0.008$), with the valgus knee brace bordering significance ($p=0.054$) in comparison to the control shoe.
Conclusions: Our findings demonstrate that using a combination of an off-the-shelf valgus knee brace and off-the-shelf lateral wedge insole significantly reduces knee loading during stair ascent, during early- and late-single support in comparison to a control shoe. However, it was only during late-single support where the combination was significantly different to the orthotic treatments alone. This initial study supports previous literature on custom designed braces and insoles. Given that adherence to valgus knee braces is a challenge, one potential outcome of this study would be for an individual to wear a lateral wedged insole and use the valgus knee brace at times of heavy activities during the day. Future research investigating beneficial clinical effects are needed.

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FUNCTIONAL RECOVERY AFTER TOTAL JOINT REPLACEMENT IN HIP OSTEOARTHRITIS: COMPARISON BETWEEN ANTEROLATERAL MINI-INVASIVE VERSUS POSTERIOR APPROACH

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Purposes. One of the difficulties in evaluating functional recovery after total hip replacement (THR) in hip osteoarthritis lies in the fact that surgical assessment is mostly subjective. The aim of the study was to compare functional recovery after THR according to two different surgical approaches not only from a conventional clinical perspective but also with regard to a quantified gait analysis.
Methods. Prospective pilot study comparing two THR approaches at short and medium terms: mini-invasive antero-lateral Rottinger approach vs. posterior 'Moore' approach in 25 patients suffering from hip osteoarthritis. Functional evaluation were performed using WOMAC questionnaire, Harris Hip Score and the Postel Merle d'Aubigne scores and 3D gait analysis including standard gait parameters, hip kinematics angles and postural analysis.
Results. The effect size (>1) was high for both surgical approaches but statistically greater improvement in PMA was noted at D45 and D180 in favour of the RoA group. The 3D gait analysis at D180 did not reveal any difference between groups for the standard gait parameters. All of the patients had significantly increased their gait speed at 6 months (v0.9 m/s after THR). This improvement was induced by increased stride length, since step frequency was identical (data not shown). The only significant difference between groups for kinematics angles was greater hip abduction in the MoA group at 6 months ($p= 0.024$), which was not noted at baseline ($p=0.14$). Maximal hip extension seemed to be greater in both groups after THR, but the difference did not reach statistical significance. . A greater improvement in postural stability was also detected in this group .
Conclusion. This study is the first to compare two specific references surgical approaches in term of functional recovery using validated subjective questionnaires and innovative 3D gait parameters. These results suggested that the Rottinger approach procured in terms of effect size faster clinical recovery than the Moore approach and better postural stability at 6 months for hip osteoarthritis patients. This postural gain might be explained by better preservation of the muscles involved in the pelvis stability in the standing position.

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TOTAL HIP REPLACEMENT NONRESPONDERS WITH HIGH BASELINE CLINICAL SCORES HAVE SIMILAR GAIT IMPAIRMENT AS THOSE WITH LOW BASELINE CLINICAL SCORES

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Purpose: It is known that not all patients respond to total hip replacement (THR). We recently reported significant gait impairment in THR nonresponders compared to responders, but also noted considerable variability in the nonresponders' preoperative clinical scores. Preoperative scores indicated that some nonresponders were apparently quite well-functioning even before THR; in these cases the importance of a nonresponder designation is unclear. The purpose of this study was to investigate whether or not there are objective functional differences, measurable through gait analysis, between THR nonresponders with high vs. low preoperative clinical scores.
Methods: We used an IRB-approved repository to identify subjects with gait data and Harris Hip Scores (HHS) that was collected before primary unilateral THR and $\geq$ 6 months postoperatively (mean follow-up 15$\pm$9 mos). At each visit, 2-8 gait trials were collected at a range of self-selected walking speeds. Our variables of interest here were the walking speed, dynamic sagittal plane hip range of motion and the peak external moments in the sagittal, frontal, and transverse planes at each subject's normal speed. We adapted OMERACT-OARSI response criteria for use with the HHS, using published data comparing HHS and WOMAC properties, then used these criteria to identify responders and nonresponders. As previously reported, 18 of the 128 THR subjects identified were nonresponders. We formed two groups of nonresponders based on whether or not each subject's preoperative HHS was $\geq$ 80. This score is typically considered to represent a "good" postoperative outcome. We used t-tests to compare gait variables before and after surgery for the two groups.

Results: 7 nonresponders had preoperative HHS $\geq$ 80. There were no statistically significant differences in preoperative age (High HHS 61 $\pm$ 11 vs. Low HHS 60 $\pm$ 9 yrs, p=0.793) BMI (High HHS 29 $\pm$ 4 vs. Low HHS 28 $\pm$ 6 kg/m^2, p=0.924) or gender distribution (High HHS 3F/4M vs. Low HHS 7F/4M, p=0.387) between the two nonresponder groups. There were no significant differences in gait variables before surgery (p=0.215-p=0.936) or after surgery (Figure 1). Pre-to-postoperative change in gait variables did not differ between the groups (p=0.140-0.857).

Conclusions: Among THR subjects who were nonresponders, the 36% with high preoperative HHS had similar gait variables to those with low scores. Notably none of the responders had preoperative HHS $\geq$ 80. Preoperative findings confirm that the functional impairment that leads some patients to seek THR may not be reflected in their clinical scores; gait analysis may provide additional useful information. This work further suggests that the OMERACT-OARSI response criteria indeed capture meaningful functional recovery or residual impairment, even in patients with high absolute scores. Patients with high preoperative clinical scores may not always be considered good surgical candidates because they may lack sufficient capacity to improve. This study suggests that good preoperative clinical status need not be a contraindication for THR, but more work is needed to determine how to measure and improve functional status in such patients.

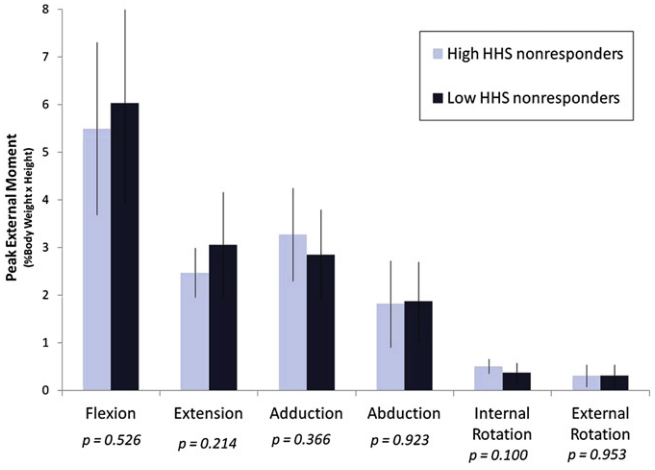

Figure 1. There were no differences in peak external moments between THR nonresponders with high preoperative HHS (>=80) or low preoperative HHS (<80). The adduction, internal rotation and external rotation moments were significantly reduced in nonresponders compared to responders.

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DOES REDUCING CO-CONTRACTION DECREASE PAIN IN PATIENTS WITH KNEE OSTEOARTHRITIS?

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Purpose: Previous research has consistently demonstrated elevated levels muscle of co-contraction in patients with knee OA. The level of co-contraction is typically highest between the medial hamstrings and medial quadriceps and occurs during the early stance phase of walking. It has been suggested that patients with knee OA increase muscle activity in order to maintain knee joint stability. However, given that increased co-contraction will increase loading across the knee joint, it could equally be a maladaptive response which acts to maintain the patient in a state of chronic pain. If this is the case then we would expect decreases in co-contraction to be accompanied by reductions in clinical pain.

The Alexander Technique (AT) is a method of movement re-education which aims to alter patterns of muscle tension. A recent large scale trial demonstrated that the AT can provide symptom relief for patients with chronic low back pain and another study found the AT was able to reduce spinal stiffness. This led the authors to suggest that AT may be effective because it rebalances ongoing muscle activity (muscle tone). Given the focus of the AT on patterns of muscle tension, it may be an effective method for reducing increased co-contraction in patients with knee OA.

We investigated whether the Alexander Technique would be effective at reducing co-contraction and pain in patients suffering with knee OA. In addition, we investigated whether any decreases in co-contraction would be accompanied by decreases in pain.

Methods: A total of n=11 patients (5 male) suffering with knee OA were recruited from primary care. Each patient underwent a baseline biomechanical gait assessment after which they were given 20 lessons of instruction in the AT. Each patient was then reassessed after the intervention. At each of the two assessment points, EMG data were collected and used to quantify the level of co-contraction during walking between the quadriceps and hamstrings. In addition, kinematic and kinetic data were collected for the lower extremity segments. Clinical pain/disability was assessed using the WOMAC instrument and individual pain scores were obtained by summing the items from the WOMAC questionnaire which focus specifically on pain.

Results: Following instruction in the AT, there was a significant (p<0.01) reduction of 15% in medial co-contraction. However, no changes were observed in lateral co-contraction or in any kinematic/kinetic variables. In addition, there was a 56% decrease (p<0.01) from 45 to 20 in the WOMAC score and a decrease of 60% (p<0.01) in the WOMAC pain score. The analysis revealed a relatively strong correlation of r=-0.67 (p<0.05) between the change in medial co-contraction and the change in the WOMAC pain score.

Conclusions: The finding of a strong correlation suggests that the AT was effective at reducing pain/disability because it reduced muscular co-contraction. Although these finding suggest that elevated co-contraction may be a maladaptive response, further work is needed to understand whether reducing co-contraction in patients with knee OA compromises knee joint stability. Although future large-scale studies are required, our results demonstrate the potential for interventions, such as the AT, which focus on reducing levels of muscle activity during functional activity.

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LOWER LIMB STRENGTH AND GAIT BIOMECHANICS OF INDIVIDUALS WITH END-STAGE HIP OSTEOARTHRITIS

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Purpose: To analyze the functional status and trunk, hip, and knee biomechanics of subjects with end-stage hip osteoarthritis (OA) during over-ground walking.

Methods: Six subjects (1 male, 5 females, 61.5 $\pm$ 7.76 age, 1.66 $\pm$ 0.02m height, 77.35 $\pm$ 13.09kg weight) who were scheduled for unilateral total hip arthroplasty were recruited to participate in this study. The Hip Harris Score was assessed for the surgical limb (SX) and pain in both hips was assessed using a visual analog scale where 0 equaled no pain and 10 equaled worst pain imaginable. Isometric hip abductor strength was measured using a hand held dynamometer with the lower limbs stabilized using a non-elastic belt. Isometric quadriceps strength was measured using an electromechanical dynamometer. Strength measures were taken bilaterally and the maximal value from three trials was used in the analysis. Kinematic and kinetic data were collected during over-ground walking at self-selected speed using an 8 camera motion capture system and two force platforms. Trunk lateral lean and sagittal and frontal plane kinematic and kinetic variables at the hip and knee joints were calculated using inverse dynamics during the stance phase of gait. Between limb differences for peak lateral trunk lean, peak hip adduction, peak hip flexion and peak external adduction hip moment were analyzed using a paired-sample t-test. Pain and strength were also compared between the SX and non-surgical (NSX) limbs using a paired-sample t-test.

Results: The Hip Harris Score for the SX limb was 43 $\pm$ 10%. The SX hip was significantly more painful than the NSX limb (mean differences [MD]: 4.66 $\pm$ 3.32, p=.019, d=1.40) and significantly weaker (abductor strength MD: -35.11 $\pm$ 16.28 N, p=.003, d=-2.15). Differences between limbs in quadriceps strength approached significant levels with the SX limb being -150.33 $\pm$ 166.45 N weaker (p=.078, d=-0.90). On the SX limb, subjects had greater lateral trunk lean (MD: -5.47 $\pm$ 3.53 degree, p=.013, d=2.01, figure 1A) and greater peak hip adduction (MD: 4.41 $\pm$ 2.19 degree, p=.004, d=1.54, figure 1B). Although peak hip extension was highly variable, subjects tended to have less hip extension on the SX limb (MD: -7.81±7.79 degree, p=.074, d=-0.92). Although no